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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/544,344	04/06/2000	Arthur W. Snow	0064612-0010	8024

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Associate Counsel (Patents)
Code 10082
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EXAMINER	
SODERQUIST, ARLEN	

ART UNIT	PAPER NUMBER
1743	

DATE MAILED: 12/10/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/544,344	SNOW ET AL.	
	Examiner	Art Unit	
	Arlen Soderquist	1743	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *07 October 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,2,4-9,21,22,25-38 and 40-45* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2,4-9,21,22,25-27,29-38 and 40-45* is/are rejected.

7)☒ Claim(s) *28* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *06 April 2000* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on October 7, 2004 has been entered.

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claims 1-2, 4-9, 33-38 and 40-42 are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for a substrate having the multiplicity of particles in three-dimensional close-packed orientation thereon, does not reasonably provide enablement for the multiplicity of particles in three-dimensional close-packed orientation by itself. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the invention commensurate in scope with these claims. All of the examples and disclosure directed to a multiplicity of particles in three-dimensional close-packed orientation is in combination with a substrate upon which the particles in three-dimensional close-packed orientation are formed. See page 17, line 8 through page 19, line 2 of the instant specification for the only methods for forming the multiplicity of particles in three-dimensional close-packed orientation that are taught in the specification. Applicant and the art of record do not teach any other manner of making the particles in three-dimensional close-packed orientation. Thus, the above claims require a substrate in order to meet the requirement for an article of manufacture suitable for use in determining whether or in what amount a chemical species is present in a target environment.

4. Claims 37-38 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The "heterofunctionally substituted aliphatic thiol" does not have antecedent basis in claim 5. There might by some possibility of antecedent basis in claims 9 or 26 but the language is not appropriate for that and the claims are not treated further.

5. In the rejections that follow, examiner will be citing portions of the instant specification to show that various claimed properties are inherent in the teachings of the applied references. The format used will be bold italicized letters contained within parentheses.

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

7. Claims 1-2, 4-5, 7-9, 21-22, 25-27, 33-34 and 41 are rejected under 35 U.S.C. 102(b) as being anticipated by Bethell (*J. Electroanal. Chem.*). In the paper Bethell describes simple methods for the production of Au nanoparticles with narrow size distributions by reduction of tetrachloroaurate solutions in the presence of thiol-containing organic compounds which self-assemble on the Au surface. Stable solutions of somewhat larger particles can be produced if the thiol is absent. The thiol-derivatized materials are stable in air over long periods and can be handled in much the same way as simple organic compounds. Page 138, column 1, last full paragraph teaches derivatized particles having a core diameter of 1.5-3 nm with particles that are derivatized with nonanethiol having a mass suggesting a gold content of about 150 atoms. Subheading 2.1 contains a reference to an article by M. Brust that is also cited in the instant specification as one of the methods for making the metal core-ligand particles of the instant invention (***see page 13, line 23 to page 14, line 8***). In figure 1(b) a spectrum of dodecanethiol-derivatized particles is presented (***see examples 10-13, page 33 line 9 to page 34, line 10 for a description of particles made with dodecanethiol***) . Table 1 teaches a range of dithiol containing molecules. Each of these is clearly within the thiol derivatives taught in the instant specification (***see page 12 line 21 to page 13 line 11 and 26-30 page 39, line 12 to page 41, line 23***). Using dithiols as the derivatizing spacer units, methods were developed for the preparation of materials in 3-dimensional form and as thin films attached to a solid substrate (figure 3, and the only full paragraph on page 139). (***A comparison of this procedure with that found in examples 26-30 shows that there is significant similarity and that the Bethell process forms a self-assembled layered structure as in the examples.***) Such materials show conductivities that mimic the behavior of semiconductors and that depend markedly on the structure of the dithiol

used to link the Au particles together. Thus there is inherently a structure capable of being used to measure conductivity. The increase in conductivity with increasing temperature probably involves activated electron hopping from particle to particle. Surfaces treated with a coating of the materials show electroreflectance changes with applied potential that also differ according to the structure of the dithiol spacer. Unusual effects were observed on heterogeneous electron transfer from electrode surfaces treated with layers of the Au nanoparticles and dithiol spacers. Applications for these nanostructured materials can be envisaged, which range from submicroelectronic devices and circuitry to electrical modification of the reflectance of glass. Such applications will require a multidisciplinary approach with a substantial organic chemical research input. Section 4 and figure 5 discuss other methods of making the clusters which use multi-functional groups on the ligand layer surrounding the metal core. (***Additional sections of the instant specification that are relevant to the inherency of the Bethell structure are page 13, lines 16-18 teaching that the thickness of the ligand shell is determined by the size of the ligand molecule and page 24, lines 15-25 showing that ligand shell thickness on particles made with of alkanethiols having 6, 8, 12 or 16 carbons, C6, C8, C12 and C16, are 0.71 nm, 0.86 nm, 1.16 nm and 1.58 nm, respectively. This clearly shows that the thickness of the ligand shell of the particles is anticipated by the Bethell reference due to the use of similar compounds to synthesize the self assembled materials in a similar manner.***)

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

9. Claims 2, 4, 6, and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bethell as applied to claims 1 and 22 above, and further in view of Natan (US 5,609,907). Bethell does not teach other types of metal colloids or the use of amine functions in the coating materials.

In the patent Natan teaches the formation of self-assembled metal colloid layers. Figure 1A with its associated discussion teach that the colloids can be gold, silver or other suitable metals. Column 3, lines 39-59 and the brief description of Figures 1A and 1B teach the additional use of amine and other functional groups in addition to thiols used to immobilize the colloids on a surface. The brief discussion of the figures also includes colloids having two layers of metal. Figure 1D shows the various levels of self-assembled colloids including multilayered (bulk).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the metal cores and metal interacting functional groups of Natan into the self-assembled colloid structures of Bethell because as shown by Natan the specifically claimed metals and functional groups would have been recognized as functional equivalents to those of Bethell relative to the formation of the self assembled colloid layers.

10. Claims 27, 29-32 and 43-45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bethell as applied to claims 1-2, 4-5, 7-9, 21-22, 25-27, 33-34 and 41 above, and further in view of Terrill and Andres. Bethell does not teach the type of electrode used or the measurement equipment used.

In the paper Terrill (***cited in the instant specification on page 26, lines 9-12***) discusses NMR, SAXS, Thermal, and Electron Hopping Studies of alkanethiol stabilized gold cluster monolayers in three dimensions. Au clusters stabilized by chemisorbed monolayers of octane-, dodecane-, or hexadecanethiolate were studied in solution and in the solid phase. These materials can be pumped free of solvent to form a dark brown solid that can be re-dissolved in nonpolar solvents. Their exceptional stability suggests that they may be viewed as cluster compounds. The self-assembled alkanethiolate monolayers stabilizing the metal clusters can be studied by using techniques that are insufficiently sensitive for study of a monolayer on a flat surface (e.g., ^{1}H and ^{13}C NMR, elemental analysis, DSC, thermogravimetry (TGA), diffusion-ordered NMR spectroscopy (DOSY)). Results from such measurements (combined

with SAXS data on solutions of the clusters and AFM and STM images) are consistent with a small, monodisperse (12 Å radius) Au core, which modeled as a sphere contains ~ 400 Au atoms and ~ 126 alkanethiolate chains, or if modeled as a cuboctahedral structure contains 309 Au atoms and ~ 95 alkanethiolate chains. High-resolution NMR spectra of cluster solutions display well-defined resonances except for methylenes nearest the Au interface; the absence of the latter resonance is attributed to a combination of broadening mechanisms based on the discontinuous change in magnetic susceptibility at the metal-hydrocarbon interface and residual dipolar interactions. Films of the dry, solid cluster compound on interdigitated array electrodes (see pages 12538-12539, experimental section for preparation and measurements) exhibit current-potential responses characteristic of electron hopping conductivity in which electrons tunnel from Au core to Au core. The electron hopping rate decreases and the activation barrier increases systematically at longer alkane chain length. The results are consistent with electron transport rate control being a combination of thermally activated electron transfer to create oppositely charged Au cores (cermet theory) and distance-dependent tunneling (β= 1.2Å-1) through the oriented alkanethiolate layers separating them. See pages 12545 - 12548 for a discussion of the electrical measurements.

In the paper Andres teaches self-assembly of a two-dimensional superlattice of molecularly linked metal clusters. Close-packed planar arrays of nanometer-diameter gold clusters that are covalently linked to each other by rigid, double-ended organic molecules were self-assembled. Au nanocrystals, each encapsulated by a monolayer of alkyl thiol molecules were cast from a colloidal solution onto a flat substrate to form a close-packed cluster monolayer. Organic interconnects (aryl dithiols or aryl diisonitriles) displaced the alkyl thiol molecules and covalently linked adjacent clusters in the monolayer to form a two-dimensional superlattice of metal quantum dots coupled by uniform tunnel junctions. Electrical conductance through such a superlattice of 3.7-nm-diameter Au clusters, deposited on a SiO_2 substrate in the gap between two Au contacts and linked by an aryl di-isonitrile [1,4-di(4-isocyanophenylethynyl)-2-ethylbenene], exhibited nonlinear Coulomb charging behavior. Page 1692 in the two paragraphs that bridge the three columns, ligand shell thickness of ~1.2 nanometers are taught for the dodecanethiol ligand shell along with the possibility that the

molecules oh adjacent clusters interpenetrate to give a cluster spacing that is less than the expected layer thickness. For the dithiol linked clusters the spacing is about 1.7 nm between clusters using a 2 nm length molecule as the linking molecule. In the last full paragraph of the center column of page 1691, Andres teaches that the synthetic method used produces particle that are equivalent to those produced by the Brust method (see reference 5). The advantage of using the Andres method is flexibility in the formation of the particles.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the electrodes and measurement apparatus of Terrill into the formation method of Bethell because of their known use and sensitivity for measuring resistivity of self-assembled colloid clusters as shown by Terrill. It also would have been obvious to one of ordinary skill in the art at the time of the invention to use the ligand displacement method of forming the linked clusters as taught by Anders in producing the layered structure of Bethell because of the greater flexibility in synthesis as taught by Andres

11. Applicant's arguments filed October 7, 2004 have been fully considered but they are not persuasive. First examiner agrees that for a reference to anticipate a claim every element of the claims must be disclosed. However the requirement is not that each element of the claim be disclosed with the specific language used in the claim. Additionally, the disclosure is fully anticipatory if the property or limitation is an inherent property of the device or article. Relative to the thickness of the coating in Bethell it should be clear that the thickness is an inherent property of the layer of material. It also should be pointed out that the independent claims that are rejected as anticipated by Bethell do not place any limitation on the type of functionality in the tail portion of the ligand used in the encapsulating layer. Also page 17, line 22 to page 18, line 4 of the instant specification teaches the use of a dithiol in the formation of the material. Thus a dithiol is within the scope of the anticipated independent claims. Since Bethell uses the same materials as in the instant specification (thiols with a carbon chain between 3 and 20 atoms long, see page 13, lines 10-11 of the instant specification) and synthesizes the particles by the same method or a method equivalent to that found in the instant specification, the thickness limitation is anticipated by Bethell. Relative to the presence of electrodes, they would be found in the device used to measure the electrical properties of the Bethell materials. The fact that the structure is not taught as being used for applicant's intended purpose does not in any way prevent

the taught structure from being capable of use in the intended manner. In response to applicant's argument that the Bethell reference does not teach the structure used for sensing, a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. In a claim drawn to a process of making, the intended use must result in a manipulative difference as compared to the prior art. See *In re Casey*, 152 USPQ 235 (CCPA 1967) and *In re Otto*, 136 USPQ 458, 459 (CCPA 1963). Examiner would ask what is the structural difference is required to be present for a configuration for sensing that sets applicant's device apart from the structure used by Bethell to measure the conductivity/resistivity of the materials? Also, how is this reflect in the language of the claims? Examiner requests that applicant respond to these questions with specific structure disclosed and supported in the specification rather than broad functional terms. If the distinction is that there are two types of ligands, a linker and one that interacts with the chemical species, present in the multiplicity of particles in a three-dimensional close-packed orientation, then the claims should specifically be limited to that structure. If the difference is that a single type of hydrocarbon tail or heterosubstituted hydrocarbon tail is the only ligand present, then the claims should be so limited. Examiner points out that the interaction with a chemical species is an inherent property of the material being used to interact with the species. Thus since the same materials are taught by Bethell as found in the instant specification, the body of the claim does not depend on the recitation of a chemical species for completeness and the limitations are able to stand alone. Applicant is directed to claim 1 relative to arguments about the sensor being an electrical chemical sensing device. Claim 1 is of a scope that encompasses much more than electrically sensing a chemical of interest. Relative to the recitation of a sensor, page 1, line 19 to page 17, line 7 teach both optical and electrical properties being measured. Furthermore page 19 lines 3-12 teach a battery and a current meter as the equipment necessary to measure (sense) the electrical conductivity to determine if change has occurred. Therefore this is the scope examined in the interpretation of the general recitation of a sensor as found in most of the claims.

The combination including the Natan reference is used to show that other types of ligands and metals can be used to form the particles. The obviousness is based on the similarity of the

methods and the final products. The claims being rejected by the combination are generally the article of manufacture rather than the sensor claims. Thus the claims are directed toward an article that could have several uses such as an optical sensor. This is consistent with the instant specification as noted above. Thus the combination of Bethell with Natan is a proper combination showing the obviousness of substituting the materials of Bethell with other materials.

Relative to the combination including the Terrill reference applicant is first directed to original claim 24, which set a film thickness of 5 to 10,000 nm (0.005 – 10 μm). Thus about half of the range of the film thickness taught by Terrill is within the specifically claimed thickness of original claim 24. Additionally the reference is cited in the instant specification as noted above. Thus Terrill is dealing with particles as are instantly claimed by this very fact! Again relative to the method of forming the material through spraying, the claims are not limited to a material produced by that method and the argument is not commensurate in scope with the claims. Relative to the layering method, the Andres reference clearly shows the difference between the method of Bethell and the claimed method to be obvious because of the flexibility offered using a ligand displacement method.

12. Claim 28 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. The art of record fails to teach or fairly suggest a spraying method to form the three-dimensional array of particles.

13. Claims 35-38, 40 and 42 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112, second paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims. The art of record fails to teach or suggest the claims combination or elements. Relative to claims 35-36, it is noted that although the respective elements are conventional as evidenced by the page 21, line 17 to page 22, line 8, examiner was not able to determine if they are part of the measurement apparatus taught by Terrill.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Arlen Soderquist whose current telephone number is (571) 272-1265 as a result of the examiner moving to the new USPTO location. The examiner's schedule

is variable between the hours of about 5:30 AM to about 5:00 PM on Monday through Thursday and alternate Fridays.

A general phone number for the organization to which this application is assigned is (571) 272-1700. The fax phone number to file official papers for this application or proceeding is (703) 872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

December 7, 2004

ARLEN SODERQUIST
PRIMARY EXAMINER